Form Approved
OMB No. 0704-0188

1. AGENCY USE ONLY (Leave blank)	2. REPORT DATE	3. REPORT TYPE AND DATES COVERED
	28 May 1996	Final Report (07-95 to 07-96)

4. TITLE AND SUBTITLE

A Simulated Analysis of the Accessibility to Health-care Services in IACH Through the Patient Appointment System

5. FUNDING NUMBERS

6. AUTHOR(S)

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7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)

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17a-96

8. PERFORMING ORGANIZATION REPORT NUMBER

9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)

U.S. Army Medical Department Center & School
Bldg 2841 MCCS-HRA U.S. Army-Baylor University
  GP in HCA
3151 Scott Road
Ft. Sam Houston, TX 78234-6135

10. SPONSORING/MONITORING AGENCY REPORT

11. SUPPLEMENTARY NOTES

12a. DISTRIBUTION/AVAILABILITY STATEMENT

Approved for public release; distribution

DTIC QUALITY INSPECTED 3

12b. DISTRIBUTION CODE

13. ABSTRACT (Maximum 200 words)

The purpose of this study is to determine if the PAS is an obstacle to beneficiaries seeking care at IACH and does this inhibit the facility from meeting the patient access standards as prescribed by the TRICARE program. Through simulation this study attempts to determine the operational efficiency of the patient appointment system (PAS) identified in the facility's business plan to continue functioning after implementation of the Region 5 TRICARE contract. The simulation will also serve in the near future as a mechanism for managers of the facility to test proposed solutions to improve PAS operations. Lastly, the simulation provides evidence to dispel the stigma associated with the PAS which has made it a source of dissatisfaction with the facility's staff and beneficiary population. Additionally, an analysis of the provider appointment templates utilized by the PAS determined the availabaility of services offered by IACH within the primary care setting. The appointment template analysis led to the conclusion that the facility is capable of meeting its access standards as rerquired in the TRICARE contract.

14. SUBJECT TERMS

Simulation, Appointment Systems, Access, TRICARE

15. NUMBER OF PAGES

88

16. PRICE CODE

17. SECURITY CLASSIFICATION OF REPORT	18. SECURITY CLASSIFICATION OF THIS PAGE	19. SECURITY CLASSIFICATION OF ABSTRACT	20. LIMITATION OF ABSTRACT
N/A	N/A	N/A	N/A

U. S. ARMY-BAYLOR UNIVERSITY
GRADUATE PROGRAM IN HEALTH CARE ADMINISTRATION

**A simulated analysis of the accessibility to healthcare services in
Ireland Army Community Hospital through the
Patient Appointment System**

A Graduate Management Project (GMP)
Submitted To LTC Holmes
In Fulfillment Of Requirements For Award of a Masters degree in
Healthcare Administration

By
CPT William B. Tilson

Fort Knox, Kentucky
May 27, 1996

Acknowledgements

ABSTRACT

The purpose of this study is to determine if the PAS is an obstacle to beneficiaries seeking care at IACH and does this inhibit the facility from meeting the patient access standards as prescribed by the TRICARE program. Through simulation this study attempts to determine the operational efficiency of the patient appointment system (PAS) identified in the facility's business plan to continue functioning after implementation of the Region 5 TRICARE contract. The simulation will also serve in the near future as a mechanism for managers of the facility to test proposed solutions to improve PAS operations. Lastly, the simulation provides evidence to dispel the stigma associated with the PAS which has made it a source of dissatisfaction with the facility's staff and beneficiary population. Additionally, an analysis of the provider appointment templates utilized by the PAS determined the availability of services offered by IACH within the primary care setting. The appointment template analysis led to the conclusion that the facility is capable of meeting its access standards as required in the TRICARE contract.

The timeliness of this study offers an additional source of information to the facility as it prepares to move toward TRICARE. The data collection period for IACH is scheduled to begin August 1996. This project was driven by previous research efforts that identified patient dissatisfaction with the PAS. This study focused on this situation by developing a tool that could assist in the development and analysis of improvements in appointment operations within the facility in anticipation of increasing customer satisfaction. Improving patient satisfaction should result in more beneficiaries choosing to utilize the MTF and enroll in the MTF TRICARE Prime offering instead of the Contractor's Prime network. Increased enrollment in the MTF Prime will mean more CHAMPUS dollars being budgeted for the facility. Under the TRICARE Alternative Financing program this will allow the facility to initiate more programs to recapture further CHAMPUS dollars.

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TRICARE Service Center (TSC)

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GLOSSARY

Balance Billing - billing by a provider who charges more than the CHAMPUS- allowable fee, asking the patient to pay the rest.

Beneficiary - anyone eligible for military healthcare, including active duty, retired military and their families.

CHAMPUS Allowable - the amount CHAMPUS regards as a fair price for a given service and will help pay. For services given by non-participating providers, any excess charges must be paid by the patient.

CHAMPUS - Cost sharing program which helps military families and retirees pay for civilian care when military care is not available. TRICARE is a CHAMPUS program.

Copayment/Copay/Cost Share - a certain percentage of the cost of care which patients must pay even for care covered by CHAMPUS.

Deductible - an amount that a patient must pay out of their pocket for care before CHAMPUS begins to share costs.

Direct Care/In-House Care - care given in MTF by military, civil service, or contract providers.

Empanelment - assigning patients to a PCM.

Enrollment - signing up for TRICARE Prime at TSC. Enrollment is for one year.

Health Care Finder (HCF) - person who makes test/subspecialty care appointments for patients. Under TRICARE, the HCF will be a contractor employee who makes appointments in the MTF or contractor network.

Managed Care - system in which patients do not shop for their care. PCMs act as patient advocates by monitoring care and avoiding unnecessary care. Such systems negotiate discount fees with providers stressing wellness and fitness though health promotion and preventive medicine.

Medical Treatment Facility (MTF) - in context refers to military hospitals/clinics.

Preferred Provider Network (PPN) - group of civilian practitioners organized by the regional TRICARE contractor to supplement military direct care in TRICARE Prime and Extra. In exchange for contractors referrals, PPN members discount fees (to CHAMPUS allowable or less) for TRICARE users. and file claims for patients. PPN members must meet the same professional

standards as MTF providers.

Primary Care Manger (PCM) - a patient's initial provider for any medical need, who makes referrals for tests/specialty care, and monitors each case to ensure adequacy/continuity of care while avoiding unneeded care. Usually a physician but some are Physician Assistants (PAs) or Nurse Practitioners (NPs). In TRICARE Prime, PCMs will be a part of the MTF staff whenever possible.

Third Party Collections (TPC) - a program established by the government to allow for the collection of payment from liability insurers for health services provided to other than active duty service members in military healthcare treatment facilities.

TRICARE Extra - Voluntary option that patients can choose case-by-case, merely by using the contractors PPN. No enrollment is required for this plan.

TRICARE Prime - HMO type option offering true managed care, centered on an MTF, supplemented by a contractor's PPN. One must enroll for this plan.

TRICARE Standard - Same as standard CHAMPUS: beneficiary can pick any provider that accepts CHAMPUS reimbursement. Beneficiaries can also chose other providers that do not accept CHAMPUS if they are willing to pay out-of-pocket for their care or utilize other insurance coverage they may have. No enrollment is required for this plan.

TRICARE Service Center (TSC) - a one-stop shopping center for beneficiaries, operated by the TRICARE contractor. TRICARE Prime enrollment, HCF services, etc., are found here.

INTRODUCTION

As the concern for American's health grows, managers of healthcare services must improve the efficiency in which health services are offered. "In this era of national debate on reforming our national health care system, the health care industry eagerly awaits decisions that will affect its future. As President Clinton initiated the *Health Security Act*, policymakers and the public developed high expectations for the debate's outcome. (Kongstvedt 1995, 10)." The spirited debates held by the 103rd Congress resulted in the Health Securities Act not being passed by the legislature. However, the rapid expansion of managed health care within this country has picked up where the Health Securities Act left off and has led the way for healthcare reform.

During the Clinton administration's quest for healthcare reform the Military Health Service System (MHSS) was identified as a model from which the country could base its reform initiatives. The U.S. military has undergone many initiatives to improve the delivery of healthcare services to its beneficiary population. The necessity for reform within the MHSS is even more pressing because of the current downsizing of the Department of Defense (DoD) and the continually decreasing nature of its annual budget. These factors, combined with Congressional concern about the differences in the level of access and benefits from one military facility to another, and patient dissatisfaction with access, are the issues that make change in the military care system imperative.

Conditions which prompted the study

As Ireland Army Community Hospital (IACH) and other facilities within the MHSS move to operate under capitated budgets and TRICARE, healthcare managers must ensure under Title 10 of the United States Code (U.S.C.) that the beneficiary population has adequate access to

healthcare services. Many beneficiaries of the MHSS are dissatisfied with access to healthcare services to which they are entitled. In IACH and many other MHSS facilities, access is gained through a centralized Patient Appointment System (PAS). It is the PAS that creates dissatisfaction for many. A recent patient satisfaction study (Grey 1995) and reports from the Patient Representative have identified the PAS as being a major source of patient dissatisfaction. IACH is currently in the process of developing a strategic business plan for the implementation of TRICARE; the facility's internal environmental analysis has also identified patient dissatisfaction with the PAS as a weakness. To maintain the facility's efforts of Continuous Quality Improvement (CQI) and Quality Assurance (QA) the issue of access must be addressed in-depth to ensure that the mission, vision and goals of IACH can be met. This study was undertaken to clarify the effects of patient access through the PAS, assist the facility's strategic planning process for TRICARE, and to continue the stream of research initiated by past studies.

TRICARE

To align itself more precisely with the civilian managed healthcare market, the MHSS's newest ongoing initiative is the implementation of TRICARE (Tri-Service triple option managed care plan). As a military reproduction of the civilian managed care environment, TRICARE utilizes much of the same terminology. However, to better understand the purpose of this study there is a need to provide insight to the history of the MHSS's evolution to the TRICARE program, the organizational structure from which it is managed, the purpose and goals of TRICARE, and the standards under which TRICARE is expected to operate.

<u>History</u>

The MHSS has undergone many initiatives in efforts to improve its ability to deliver healthcare to the military beneficiary population. These initiatives include: Civilian Health and Medical Program of the Uniformed Services (CHAMPUS), Primary Care for the Uniformed Services (PRIMUS), Catchment Area Management (CAM), CHAMPUS Reform Initiative (CRI), and the Coordinated Care Program (CCP) also known as Gateway to Care. Through these initiatives the MHSS has moved from workload reimbursement and fee for service payment to operating its facilities by managing services and beneficiaries under capitated budgets.

CHAMPUS

CHAMPUS (Civilian Health and Medical Program of the Uniformed Services) was authorized by Congress in 1966. CHAMPUS is a medical benefit program that cost shares charges for medically necessary treatment provided to eligible beneficiaries by civilian sources when services are not available from the military direct care system. This program also covers outpatient care services that are not specifically prohibited by the local Military Treatment Facility (MTF) commander. Eligible beneficiaries include active-duty family members, retirees, and retiree family members. Except for active-duty family members, beneficiaries lose their CHAMPUS eligibility at age 65 and must seek care from either the direct care system or Medicare (Badgett 1990, 1).

PRIMUS

Immediately prior to the reallocation of CHAMPUS funds, the DoD started a demonstration project in 1985 to improve the delivery of CHAMPUS funded care by establishing eight civilian-managed outpatient clinics. The Army refers to these clinics as PRIMUS (Primary

Care for the Uniformed Services) clinics and the Navy as NAVICARE. The goals of the program were to act as an extension of the DoD healthcare system, improve access, reduce over utilization of MTFs, and recapture CHAMPUS workload. However, the PRIMUS program resulted in an increased patient volume with only minor reductions of the overcrowding within the MTF. The improvement in accessibility actually increased healthcare costs because the PRIMUS clinics represented an additional service without any measurable decrease in total cost (Leahy & Mouritsen 1990, 18).

CRI

The CRI (CHAMPUS Reform Initiative) debuted in August 1988 to take advantage of the enormous buying power of the DoD's 2.4 billion healthcare dollars. The intent was to eliminate the practice of paying full charges, and shift the risk from DoD to healthcare contractors who agreed to reduced fees under a provider network arrangement. CRI offered a triple-option benefit package: traditional CHAMPUS, CHAMPUS Extra (reduced out-of-pocket costs to beneficiaries for using a provider network), and CHAMPUS Prime (eliminates deductibles and requires only a $5 co-pay by the beneficiaries, but, restricts provider choice). Other benefits associated with the CRI was the relief of military beneficiaries from having to file CHAMPUS claims (Gisin & Sewell 1989, 89).

CAM

"The CAM (Catchment Area Management) demonstration project's fundamental concept was to contain military health care costs by granting the MTF commander full clinical and fiscal responsibility of the health care of all beneficiaries residing within the MTFs catchment area (Santos, Johnson, Hudak 1993, 299)". This program was intended for the MTF commander to

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more appropriately determine the level and mix of in-house direct care and ensure that the beneficiaries' needs were still met. The project scheduled as a 3-year demonstration was tested in five separate military sites (two-Army, two-Air Force, and one-Navy) during fiscal year FY 1989. The four primary objectives of the project were to: contain the growth of CHAMPUS costs, improve accessibility, improve satisfaction, and maintain quality healthcare services (Ulbricht 1992, 11).

CCP

The Coordinated Care Program was the DoD's plan for revamping the military healthcare system nationwide. On October 1, 1991 a memorandum from the Office of the Secretary of Defense (OSD) directed the implementation of several new initiatives, one specifically being a Coordinated Care Program (CCP). The memorandum stated: "The Assistant Secretary of Defense for Health Affairs (ASD(HA)) shall implement a program to ensure coordination within appropriate geographical areas of the provision of medical care through the CHAMPUS. The objective of the program shall be to maximize cost effectiveness in the delivery of high quality health care in the accomplishment of the department's mission." The program was based on the HMO "gatekeeper" concept where patients are steered to the appropriate level of care by a primary care physician (Nerio & O'Connor 1993, 38-39). The GAO reports that the Rand corporation under contract for the DoD is studying the cost effectiveness of the CRI and CAM demonstration projects. Currently, there is not a similar study planned for the CCP project (GAO October 1991).

<u>Operational Structure</u>

The key to DoD's military health care reform strategy is the regional implementation of TRICARE under the Lead Agent concept. DoD has divided CONUS (Continental United States) into twelve regions, each with a medical corps flag officer designated as the Lead Agent (LA). Each of the regions is organized around an existing medical center to ensure availability of necessary subspecialty care and to utilize existing referral patterns. The regions have enough beneficiaries residing within their geographical boundaries to achieve the concentration necessary to entice managed care contractors and support a cost effective program. Each region will be supported by a managed care support contractor who is financially at risk. The contractor will provide support to the regions MTFs by hiring staff, providing equipment, and establishing provider networks to care for beneficiaries.

The LAs work in cooperation with all the MTF commanders to develop a comprehensive plan for the delivery of healthcare in the region. This approach seeks to optimize the use of existing MTF capabilities by taking advantage of existing referral patterns and making access easier through the use of regional military resources and transportation assets. The primary functions of the LA are to coordinate and monitor the activities of the MTFs and the support contractor to ensure that contractual requirements are met. Other LA responsibilities include: (1) making modifications to contract requirements, (2) assisting the contractor in determining the size and configuration of the network, (3) ensuring that the network is capable of meeting the needs and access standards for beneficiaries in the region, and (4) supporting and assisting the activities of the regional administrative contracting officer and program manager.

Purpose and Goals

The TRICARE program applies to all military health service system beneficiaries. The program goals are:

- improve beneficiary access to care
- assure the security of a high quality, consistent health care benefit for all MHSS beneficiaries, at low cost
- preserve the choice of all non-active duty participants
- contain overall DoD health care costs

By implementing the TRICARE program on a regional basis with a LA and supporting contract, military beneficiaries will be able to move confidently from one assignment to the next knowing that they will receive a consistently high level of healthcare at each assignment and that they will have options in their health care decisions. The health services support plan pulls together all the military resources within the region and adds a network of civilian providers as necessary to ensure beneficiaries have access to the services they need at minimal cost.

The Assistant Secretary of Defense for Health Affairs (ASDHA), Dr. Stephen C. Joseph, has given several reasons for expecting TRICARE to save money.

> Military direct-care facilities are already efficient compared to the civilian sector. Their costs grow at less than half the national medical inflation rate, and the '733 Study' showed them to be at least 10% more cost-efficient than their civilian counterparts. Also, the risk-sharing feature of the TRICARE contracts gives contractors an incentive to conserve resources. ... the old system is no longer an option. If DoD cannot make TRICARE work, it will lose its health-care system entirely and all non-battlefield care will be contracted out, ... (Noyes 1995, 12).

Access Standards

Since TRICARE places restrictions on the way enrollees access care, it has established standards to ensure that beneficiaries receive access to care in a timely manner. Another

responsibility of the LA is to ensure this timely access to healthcare services for all plan

participants. Before offering an enrollment option to DoD beneficiaries, the LA and MTFs within

the region must ensure that the capabilities of the MTF and the TRICARE contractor provider

network will meet the following access standards:

- Emergency and urgent care services shall be available and accessible within the service area, 24 hours a day, seven-days a week.

- The drive time for plan enrollees generally should not exceed 30 minutes from home to the site of primary care delivery.

- The drive time to obtain specialty care, except in cases of Specialized Treatment Services, normally should not exceed one-hour.

- Maximum wait times for primary care appointments are as follows:
    * 4 weeks for a well visit (health maintenance and prevention, non-urgent)
    * 1 week for a routine visit (intervention required, non-urgent)
    * 1 day for acute illness care (early intervention required, urgent)

- Maximum wait times for specialty care appointments will be:
    * 4 weeks for a routine visit
    * 1 day for urgent care

To measure the performance of the MHSS under TRICARE in meeting these standards,

Dr. Joseph has initiated indicators and values to be used for a regional report card (Joseph 1994).

Many of these indicators are focused on the accessibility of care for the beneficiary population.

The areas to be reported on are: number and mix of providers, number of delivery sites, primary

care availability, emergency services, office wait times, and primary care appointment wait times.

"Report cards will become increasingly important given pending health care reform and the

growth of managed competition (Harris 1994, 21)." In 1995, Joseph again reiterated these same

requirements for the MHSS and stated "... military PCMs must meet the same access standards

for TRICARE Prime enrolled populations as the contractor (Joseph 1995)."

Previous Research

By focusing this study on the IACH PAS, the work of previous administrators/residents, and command directed surveys can be capitalized upon to add to the stream of research. Most of the previous research efforts were focused on the accessibility of health care provided at IACH and how it affected patient satisfaction. One study was conducted to determine the patient perceptions of healthcare services received at IACH. "The major areas of dissatisfaction were the number of calls needed to obtain an appointment and the length of time needed to wait for that appointment (Morrill 1987, 42)."

A Health Service Command (HSC) directed Special Inspection on MTF PASs found that IACH and other facilities command wide were not properly following policies and guidelines in the operation of their PAS. "In many cases, active duty (AD) and their family members were not seen within the required time-frames established by HSC PAM 40-7-1 (HSC Study 1989)." The patient appointment waiting times set by this HSC regulation are as follows:

> (1) If waiting time for AD military exceeds 3 working days, immediate action is required to correct the situation.

> (2) If waiting time for AD family members exceeds 10 working days, measures should be taken to reduce it.

After the facility decentralized the appointment system, complaints related to the inability to get an appointment only slightly exceeded the number of complaints focused on telephone access. An internal task force was then established to 'fix the system'. The Access Study in 1990 (Lashlee et al. 1990) found that many of the same deficiencies identified in the 1989 HSC Special Inspection still existed. Modifications identified to correct the PAS reiterated the recommended operating procedures as outlined in HSC PAM 40-7-1.

A telephone Traffic Study by the Directorate of Information Management (DOIM) revealed that in one week in May 1994, peak calls to the PAS occurred between 0700-0800 and 1000-1100 hours. At the same time, incoming calls to post and other hospital numbers raised the total number of Ft Knox incoming calls to a high of 8236 on that Monday and 2915 in the same week on Friday. As a result, in that week, only 9% of calls on Monday and 27% of calls on Friday, made to the PAS were completed. In review of this study, the chief nurse (Mundy) stated that a recent restructuring of the organization's management structure, had led to key positions being deleted that were responsible for the operational activities of the PAS (Mundy 1994).

A more recent study (Grey 1995) has focused on patient satisfaction. This study focused specifically on patient satisfaction with healthcare services provided at IACH. It found, "Respondent comments and complaints pointed to several areas which negatively impact on the general satisfaction level of the sample. These include widespread dissatisfaction with access, particularly the patient appointment system (Grey 1995)." The recommendations of this study identify the PAS as an area needing improvement or modification to achieve greater provider utilization within the constraints of the MHSS. Grey also suggested that the PAS at IACH warranted further investigation and research in determining the best alternatives to improve the appointment system. It is natural for an organization to work toward the reduction of complaints it receives. It is an objective of this simulation study to provide a mechanism to analyze suggested alternatives that will reduce the number of complaints filed against the PAS. "Complaints, after all, represent where the organization is failing its customers, and every good manager strives to eliminate such problems (Polonski 1995, 111)."

Strategic Planning

IACH is presently in the process of developing its strategic plan to meet the requirements designated by the guidelines for TRICARE implementation. Many answers to questions on the local implementation of TRICARE remain unanswered by the LA, NAHSSA, and MEDCOM. Because of this, planning efforts are hindered in developing valid alternatives for the future operational activities of IACH. However, planning efforts must continue to ensure the success of IACH in the managed care environment. The MHSS and IACH are faced with the same stumbling blocks as those our civilian counterparts are faced with, in restructuring healthcare delivery systems to envelop a managed care philosophy.

A key step in the strategic planning process is the establishment of a marketing plan. IACH is now starting its marketing program for the implementation of TRICARE. Efforts are being made to stimulate the enrollment of beneficiaries into the TRICARE Prime program. The largest obstacle for IACH is overcoming the local beneficiary population's perception that the facility is unresponsive to their needs. It is important that IACH develop a sound strategic plan if it is to effectively function in a managed care environment. Efforts taken to ensure the accuracy of assumptions and data used to determine empanelment populations and MTF capacity will better ensure a successful implementation of TRICARE.

Cost, Quality, Access

IACH is actively involved in continuous quality improvement efforts to meet the intent of Joint Commission on the Accreditation of Healthcare Organizations (JCAHO) requirements and its desire to make patient focused improvements in the facility's healthcare delivery environment. IACH initiates these activities through the Department of Quality Improvement (DQI). Process

improvement is a cornerstone in the facility's TQM program. As such, process improvement was

a driving factor in determining an area of study for this project. A primary technique/model used

in process improvement is FOCUS-PDCA (Rakich, Longest and Darr 1992, 422).
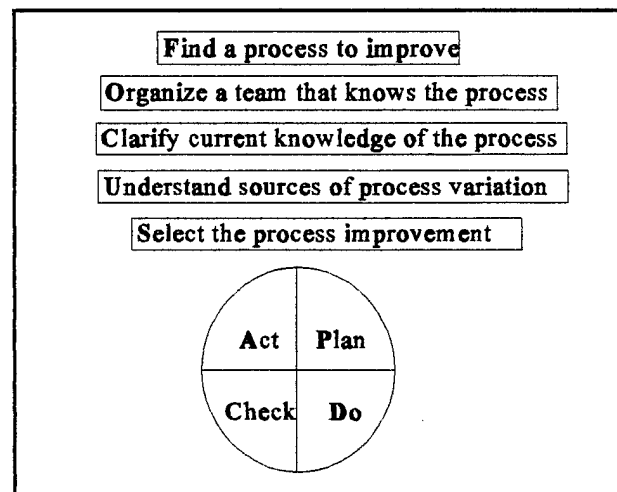
Diagram 1.
FOCUS-PDCA

The crux of the FOCUS-PDCA model is finding a process that needs improvement, resolving the

problem, and then observing the solution to ensure that it is effective. The conduct of this study

follows the FOCUS-PDCA cycle. The efforts of this study seek to improve the quality of patient

care delivered at IACH. "The best ideas for improving organizational processes come from the

customers who depend on the organization's products and services. The reason is simple: Quality

in the modern sense is defined as meeting the needs of customers. Who better than the customer

can tell us what is needed and how we are doing? (Berwick, Godfrey, Roessner 1990 49)." The

idea for this study has come from the patients themselves, through the work of previous

administrators conducting patient satisfaction surveys/studies.

The most recent patient satisfaction study (Grey 1995) identified that the number one

dissatisfier was accessibility to healthcare services. "Patient satisfaction with primary care

encompasses access to care, continuity of care, and the interpersonal nature of care. ... Access to care includes being able to make an appointment to see one's physician in a timely fashion, not having to wait a long time in the physician's office, and being able to speak to one's physician on the telephone (Barr 1995, 355)."

With patient access as the primary focal point of this study, other factors must also be considered in the conduct of the study such as the cost and quality of services. Access is a major part of the healthcare management three legged stool (cost, quality, and access). This concept is based on the idea that any effects on one leg of the three legged stool has impact on the other two. Healthcare value is derived from achieving a cost effective outcome. Patients expect to see results for improved health measured not only with clinical indicators, but with the more subjective measures of improved functional ability, personal well-being, satisfaction, and quality of life (Addleman 1995, 50). If any improvement can be made in the PAS that can improve patient satisfaction by improving access, then the cost of this improvement must be weighed in the decision process. It is here, with cost factors, that the simulation model can provide assistance in making more accurate determinations in staffing overhead. Determination as to the perceived quality of care by the patient, as well as any improved benefit in health care outcomes must also be figured into the decision process. This study will provide some information in the management decision making process so that some useful improvements can be implemented in providing quality healthcare services to IACH's patients.

Statement of the Problem: The Research Question

The purpose of this research project was to determine if the PAS presents a obstacle in beneficiaries seeking a care at IACH. Past research (Grey 1995) conducted at IACH, identified

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that the patient population is dissatisfied with the quality of the mechanism/processes provided to access healthcare at IACH. Patient satisfaction is key to the success of this facility's TRICARE initiatives. Patient access currently requires that different patient categories be afforded certain types of appointments at designated times. This presents a recurring problem within the PAS. There are numerous different types of appointments utilized by providers at IACH. Clerks have difficulty in distinguishing the type of appointment needed by the patient and then placing the patient in the appropriate appointment category. In some instances there are not enough appointments to meet the demand. This is especially true for some of the specialty care services offered at IACH.

Under TRICARE, if the facility is unable to meet the designated access standards, it is required to send patients to the contracted health care finders (HCFs). The HCFs will then obtain appointments for beneficiaries outside of the facility within the TRICARE contractor's network. Under the TRICARE Alternate Financing Proposal, the facilities' prime enrollees seen within the contractor's provider network will result in the loss of CHAMPUS dollars that could otherwise be used to supplement the operations of the MTF.

There is a further implication that the facility may face bankruptcy if it fails to meet TRICARE access standards, or other contract requirements and improperly manages its business risk. The financial failure of MTFs under TRICARE will provide further support to governmental leaders seeking to privatize the MHSS. "The DoD's TRICARE managed-care initiative is hitting some bumps. ... Congress may be seriously considering the idea of moving the 6.5 million military dependents and retirees from CHAMPUS to the Federal Employees Health Benefits Program, or FEHBP, which now covers 4 million employees and families (Gardner 1995, 26)."

Literature Review

Simulation

"Simulation has been used increasingly for modeling complex systems, including multiple hospital units with capacity constraints, that defy mathematical analysis (Lowery, Martin 1992, 19)." A number of simulation models have been developed to examine inpatient and outpatient activities. Fetter and Thompson (1965) and Wright (1987) simulated patient arrivals to assess utilization in specific inpatient and outpatient departments within a hospital. Robinson, Wing, and Davis (1968) simulated different strategies for scheduling elective admissions. Kwak, Kuzdrall and Schmidt (1976) used simulation to determine and evaluate utilization levels of operating and recovery room facilities under different policy considerations governing patient flows. Sissouras and Moores (1976) utilized simulation to determine the proper number of beds for a coronary care unit. Vassilacopoulos (1985) presents a simulation model which helped determine the number of beds required by a community to meet its hospitalization demand. Dumas (1984 and 1985) examined the interaction of nursing services in a general hospital. Klafehn, Rakich, and Kuzdrall (1988) used a simulation model to allocate hospital inpatient beds by strategic business unit. Hancock and Walter (1984) used the simulation of patient admissions to help in the stabilization of ancillary workloads. Charnetski (1984) balanced idle time of surgeons, operating room facilities, and OR staff through simulation. Rakich, Kuzdrall, and Klafehn (1988) and Nall (1992) designed simulation models to investigate a planned Same Day surgery unit. Several researchers have simulated patient flows to examine the utilization of resources within different departments of a hospital: Klafehn and Owens (1987) studied the emergency room, Klafehn (1987) studied the radiology department, Steidley and Vanloh (1977) studied outpatient services,

Mahachek and Knabe (1984) studied obstetrical/gynecology clinics, and Klafehn, Rakich, and Kuzdrall (1989) studied an intensive care unit.

Many researchers have stated their views on the power and usefulness of simulation. "The power of simulation lies in the ability of an investigator to examine proposed changes to an existing system without physically changing the system (Klafehn, Rakich, Kuzdrall 1989, 8)." Some have utilized simulation to assess the impact of patient care policies and state, "Simulation models are ideal for assessing the performance of strategic, tactical and operational policies for hospitals. Simulation can validate a proposed policy, uncover fallacies of a proposal, or determine the sensitivity of the response to a policy change (Butler, Reeves, Karwan, Sweigart 1992, 38)." Only by using a computer simulation to track all the inter-relationships, do the boring and repetitive math and statistics, and provide clear instant visual feedback to the consequences of decisions, can managers get an overall view of complex issues. Simulation and gaming helps to develop a feel for the way the different parts of an organization or system fit together and interact (Simhealth User's Manual 1994, 6).

Simulation is a significantly useful management tool. "The most sophisticated and accurate technique for quantitative modeling is simulation. Simulation is an expansion of queuing and has received increased attention in the health services field. Simulation uses the basic idea of waiting-line analysis, but without the numerous limitations of the application of queuing (Kaluzny, Warner, Warren, and Zelman 1982, 150)." Other researchers indicate that the understanding of simulation is enhanced by a manager's familiarity with the concepts of the systems being modeled. "A system is a collection of entities functioning together to accomplish one or more common goals (Boxerman and Serota 1979, 72)." A hospital is a system that is comprised of numerous

departments. All of these departments work cooperatively to accomplish the hospital's patient care goals. "A simulation model is a tool that allows the manger to view different scenarios and examine the impact of proposed changes on a specific hospital system before an actual alteration is made or a reallocation of resources takes place (Klafehn, Rakich, and Kuzdrall 1989, 7)." The benefit of simulation lies in this "what-if" analysis regarding changes to systems and the decision making process.

Management consultants from Atlanta's Sun Health Alliance use laptop computers armed with MedModel software to illustrate various patient-volume and staffing-level scenarios to identify those areas where patient workload can be streamlined. Through the animation capabilities of the MedModel software, bottlenecks in modeled clinical areas are easy to spot. "The benefit of the animated simulation is that it visually depicts when a patient is in a queue, ... (Appleby 1995, 36)."

Using the advantages of simulation, some software programmers have developed management gaming programs to assist managers in developing and theoretically testing their ideas prior to implementing them within their organizations. A major advantage of management games is that players act in a simulated environment without their decisions having a direct effect on the real world (Schwarz 1992, 5). ASTERIKS is a PC based game dealing with scheduling and sequencing operations in hospital departments (Schwarz 1992, 5). Mastering the Transition to Capitation - Learning Lab helps managers to find the best mixture of coordinated strategies for surviving in the old health care delivery environment while preparing for the new managed care capitated environment (Hirsch and Kemeny 1994, 89).

Appointment Systems

Few studies have investigated the manner in which appointments should be provided, or when. However, standards for dealing with urgent or non-urgent consultations have been proposed (NW Faculty 1986), and the problem of dealing with urgent demands (Field 1987 and Virji 1990), or with non-attenders (Bickler 1985; Cosgrove 1990) have been the focus of research efforts centered on appointment systems. The working of appointment systems has been the basis for audit (Fishbacher and Robertson 1986) and assessment (Rutledge 1977). Investigations have centered on the functioning of such systems in relation to patient satisfaction (Hall and Dornan 1988; Allen, Devey, and Marks 1992), patient flow (Ridsdale, Carruthers, Morris, and Ridsdale 1989; Heaney, Howie, and Porter 1991; Campbell and Howell 1992) and even patient anger (Anonymous 1992). Research has found some correlation of how appointment systems work, in relation to patient views of the arrangements for seeing their doctors and the patient practices of self referrals for care (Campbell 1994). Attempts to discover why appointments are broken have concentrated in turn on the consumer, provider, and their interface (Shah, MacBride, and Lamb 1977). The consideration of the patient-provider encounter has resulted in waiting room improvements (Cammock 1973) and the wider use of patient identity cards and appointment systems (Downey 1973; Rockart and Hofman 1969). Studies focusing on patients' preference for systems find that patients using appointment systems were more satisfied than open walk-in patients (Cartwright and Anderson 1981). Patients using walk-in access are much more likely to be discouraged in seeing their doctor because of the anticipated wait than patients using appointment systems (Wilkin, et al, 1987). Studies also show that many patients would prefer to have the option to use both walk-in access and appointment systems (Allen and Marks 1988).

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Patient appointment systems are now an integral part of the healthcare environment within which the provider and patient must function, (Swarzman 1970; Rosenblut, Jonas, Wassertheil, and Meyer 1972) but, like any system, have their own problems.

Purpose

The purpose of this study is to determine if the PAS is a determent to beneficiaries seeking care at IACH and does this inhibit the facility from meeting the patient access standards as prescribed by the TRICARE program. Through simulation, this study will attempt to determine the efficiency of the patient appointment system (PAS) currently operating at IACH and projected to continue functioning under TRICARE. The simulation will also provide a mechanism for managers of the facility to test proposed solutions to improve PAS operations. Lastly, the simulation will provide a means through which management can either validate or disprove the current stigma associated with the PAS, that is its ineffectiveness and inefficiency in providing its service of scheduling appointments.

An analysis of the appointment templates utilized by the PAS will determine the availability of services offered by IACH within the primary care setting. The primary goal of this study is to contribute to the stream of research initiated by previous healthcare administrators and extend management's body of knowledge about the PAS. The objectives of this study are:

(1) provide a mechanism (simulation model) for testing proposals for improving PAS operations and enhancing patient satisfaction.

(2) provide a means (simulation model) through which management can either validate or disprove the current stigma associated with the PAS.

(3) analyze provider templates utilized by the PAS to determine the availability of services offered by IACH within it's primary care setting.

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It is anticipated that the results of this project be utilized in enhancement efforts by the management and staff that improve the accessibility of PAS services for beneficiaries making appointments, simplify methods to the processes of meeting beneficiaries appointment needs, and increase the availability of appointments for beneficiaries.

METHODS & PROCEDURES

Simulation was chosen as the primary quantitative technique in the conduct of the PAS analysis. "A decision to use simulation usually results from a perception that simulation can help resolve one or more issues associated with the design of a new system or the modification of an existing system (MedModel Users Guide 1995, 45)." The use of simulation is widespread among many U.S. corporations in their planning processes. It has also been shown to be the most favored technique by operational research analysts (Levin, et al 1992, 759).

There are several reasons why simulation is chosen for solving management problems. The actual environment is difficult to observe. Analytical solutions are not possible. Observation of the system is prohibitively expensive. Sufficient time is not available to allow the system to operate extensively. And, other methods are disruptive to the system.

The use of simulation also has some distinct disadvantages. It is not precise. A good simulation model may be very expensive to develop. Not all situations can be evaluated using simulation; only situations involving uncertainty are candidates. Simulation generates a way of evaluating solutions but it does not generate the solution technique. To be successful, model builders must have an understanding of the modeled environment (Levin, et al 1992, 759).

For simulation to be effective, a great deal of planning and organization must be done prior to the start of the project. There are six basic steps that should be followed in conducting

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simulation research. The steps are: (1) Plan the study, (2) Define the system, (3) Build the model, (4) Run experiments, (5) Analyze the output, and (6) Report results (MedModel Users Guide 1995, 46). These same basic steps have been used in the development of this project. In performing simulation studies, each step does not necessarily have to be performed in order or in its entirety before moving on to the next. Because simulation is an iterative process activities are continually refined and modified with each iteration.

> The stages of simulation are rarely performed in a structured sequence beginning with the problem definition and ending with documentation. A simulation project may involve false starts, erroneous assumptions which must later be abandoned, reformulation of the problem objectives, and repeated evaluation and redesigns of the model. If properly done, however, this iterative process should result in a simulation model which properly assesses alternatives and enhances the decision making process. (MedModel Users Guide 1995, 46)

A comparative analysis of the patient appointment templates was done to evaluate the availability and utilization of providers within the facility's primary care setting. This analysis focused on several factors concerning appointment availability. First, the number and quantity of appointments available within the primary care setting were analyzed to determine the maximum potential available appointments within the facility versus the actual available appointments within the facility. Second, the utilization rates of these appointments by the beneficiary population were analyzed to determine the present utilization of available appointments. This was anticipated to demonstrate the facility's capability of meeting its access standard requirements. An outcome showing high utilization rates would demonstrate the facility's potential inability to meet the future expanded contract access requirements. Third, the analysis should show the level of productivity within the facility's primary care setting as captured by the facility's Composite Healthcare System (CHCS) database.

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Planning the Study

There are several issues of concern for which this study has been under taken. First, how well does the current PAS function (*performance analysis*)? Second, is the current PAS operating at maximum capacity or does excess capacity exist (*capacity analysis*)? Third, once the model is developed, can suggested alternatives by other researchers for fixing the PAS effectively be incorporated in the model to analyze the alternative's performance in the PAS (*comparison study*)? After the model is completed, it is anticipated that it will be utilized for future analysis and modifications of the PAS as changes dictate the need for in operational improvements.

The analysis of the provider appointment templates should produce the same type of information as the simulation model. The analysis should provide clinical managers within the primary care setting information that should show the level of performance within the Family Medicine Clinic. It will also evaluate current versus potential appointment capacity levels. Lastly, the analysis will provide insight as to the effects of a proposal by clinical managers to enhance the availability of appointments within the primary care setting.

System Environment

IACH is a 103-bed MTF that provides a wide range of healthcare and preventive medicine services to the Ft Knox military community, their family members, the retiree population and their family members residing in the catchment area as well as, active duty Army personnel stationed in a seven-state (Illinois, Indiana, Kentucky, Michigan, Minnesota, Ohio, and Wisconsin) Health Service Area (HSA). The Ft Knox catchment area encompasses 17 counties in the Commonwealth of Kentucky and extends into six Indiana counties. The catchment area is defined by 197 postal zip codes however review of the CHCS indicates that beneficiary usage comes from

2,463 separate zip codes. Based on the Defense Medical Information System (DMIS), September 1995 the Ft Knox catchment area has 59,407 eligible beneficiaries. The population makeup is 23.4% (13,878) active duty, 31.8% (18,910) active duty family members, 17.4% (10,334) retirees, 23.2% (13,789) retirees family members, and 4.2% (2,496) other beneficiaries. The FY 95 budget for the facility was $78,489,000. CHAMPUS expenditures for patient services in the catchment area in FY 95 were approximately $16,325,000. The total number of outpatient visits for the MTF was 453,785 and the total number of admissions was 5,839. Review of the CHAMPUS and direct care provided services to the IACH beneficiary population show that in FY 95 the MTF captured 76% of all admissions and 78% of all outpatient visits. Third Party Collections (TPC) for FY 95 totaled $806,841. Over the past several years the work force has continued to slowly decline. The civilian work force has declined from 563 in FY 94 to 538 in FY 95. The military personnel roster has also declined from 479 in FY 94 to 430 in FY 95.

Defining the System to Be Modeled & Analyzed

The actual process which beneficiaries go through to make appointments is the content of this model (See Appendix A). Seeking an appointment through the IACH PAS has been a great source of patient dissatisfaction (Grey 1995). The process by which a beneficiary makes an appointment in IACH should be a simple and easy task. However, this process is complicated for several reasons. First, beneficiaries must compete for appointment times as they are released in block intervals. Because of this, the number of telephone lines and clerks working within the PAS appear to be insufficient. Second, the system is complicated by the fact that, the PAS provides appointment services for some of the MTF's clinics, but not all of them. This creates confusion for the beneficiary seeking care. There are several clinics that either schedule their own

appointments or operate on a walk-in basis only. The current standard operating procedures (SOPs) of the PAS require that providers in clinics provide appointment templates to the supervisor of the PAS. The supervisor must then translate the templates into the appointment module of CHCS for the clerks to use in processing patient appointment calls. The templates create confusion for the clerks because of the significant number and different types of appointments each healthcare provider prefers to utilize. The PAS clerks must search and properly interpret the CHCS provider appointment scheduling module and attempt to place beneficiaries in the proper appointment.

Appointments are released by the PAS on a block system. This block release of appointments works in the following manner. The release or opening of new appointments for a designated clinic is done on a specific day of each month. The appointment block for the clinic is an opening of appointments for approximately two to four weeks in length. The PAS clerks work with beneficiaries seeking appointments to fill these open appointment times. If the entire block is filled prior to a new appointment block opening then the beneficiary has no options in seeking an appointment in that clinic. The beneficiary must either wait for the new block to open or utilize CHAMPUS providers. This block release method is the result of previous attempts to prevent an inundation of the PAS when new appointments for multiple clinics are released at the same time on the same day. It is obvious how frustrations develop as the clerk and patient try to: (1) determine the right type of appointment needed, (2) find an open appointment slot within the appointment scheduling window, and (3) find a time that is convenient for the beneficiary.

The PAS is staffed with six clerks, one assistant supervisor and a supervisor. The clerks handle all incoming calls to the PAS and process patient requests for appointments. The

supervisor and assistant supervisor develop the appointment database in CHCS using the templates submitted by the practitioners and clinics. The CHCS appointment module reflects the available appointments and times for use by the clerks to fill the provider schedules with patients. The assistant supervisor also assists the clerks with unique patient situations or requests that are beyond the capability or scope of knowledge of the clerk. The hours of operation for the PAS are Monday through Friday, 0630 to 1500 hrs.

The primary care clinic in the facility that this study focused on was the Ireland Family Medicine Clinic (IFMC). This clinic is the base from which the facility is constructing its primary care practice for TRICARE. The IFMC in FY 95 was assigned five physicians and one Nurse Practitioner (NP). It had 19,216 outpatient visits and incurred $2,476,121 worth of expenses (3.1% of the total facility budget), with each patient visit costing $128.86. The hours of operation for this clinic are Monday through Friday 0630 to 1130 hours and 1300 to 1530 hours for a total of 7.5 hours of patient care time.

Assumptions

Several assumptions must be made both for the construction of the simulation model as well as the analysis of the primary care provider templates. This was necessary so that some accurate conclusions could be drawn from the results of this study. Currently the facility is undergoing many rapid changes in an effort to posture itself for the TRICARE data collection period. The size and composition of the primary care setting has changed several times since the Ambulatory Medicine business plan has been presented. The effects of past downsizing activity caused some turnover both within the PAS and the IFMC practitioners over the course of this study. This presented a potential problem in attempting to make a proper study of a process

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change. Due to the size and complexity of a hospital setting this is almost impossible if the scope of a study crosses several functional areas. Monitoring and attempting to gather information at a steady state is also compounded given an organization is in the midst of preparing for a major operational change. Such an environment exists as IACH prepares for the TRICARE data collection period and eventual implementation of the contract.

Several assumptions were necessary for the construction of the model. For this simulation, a month consisted of twenty working days. The number of personnel assigned to work in the PAS was held at a constant of six clerks and one assistant supervisor. Answered calls are considered to be completely processed calls, even though observation revealed that in many cases the supervisor and clerks returned calls to the patient instead of keeping them on hold to resolve an appointment issue. This was necessary because the automated call distribution (ACD) system and model does not capture the return call activity of the clerks and supervisor. Observation found this assumption to be the exception rather than the rule. Data collection revealed that this occurrence happened for less than one percent of the total calls to the PAS.

Some assumptions were also made for the analysis of the primary care provider templates. The number of providers was assumed to remain constant in the primary care clinic over the course of the analysis. The number of providers assigned to the clinic was held constant at four physicians and one nurse practitioner. This was necessary because over the course of the data collection period the number of providers fluctuated from as few as three to as many as five physicians. The lengths of appointment times for each appointment type used in the analysis were standardized for all the physicians and the nurse practitioner within the clinic.

Building the Model

Scope

The model simulates how an individual patient seeking care in the facility obtains an appointment through the PAS, and simulates how the appointment system functions in providing service to IACH beneficiaries. The simulation can be modified to accommodate fluctuating staff levels within the PAS. The study can also facilitate future analysis of changes in the appointment policies concerning the number and length of appointment types. The Ireland Family Medicine Clinic was selected as the focal point for analyzing provider templates because it is crucial in the establishment of the facility's primary care base. The clinic has also been identified in the facility's strategic business plan as being the initial clinic to which beneficiaries will be empaneled prior to implementation of, and once under TRICARE. Only the current operating environment has been modeled. As the provider-mix and patient-mix of this clinic changes over time, analysis must be continued to reflect future environmental changes.

Data Collection

Data collection for this study was accomplished using the CHCS and ACD reporting systems developed for on-going management analysis by the PAS supervisor. These reports provide most of data needed for the development of the model. The End of Day (EOD) Report produced by CHCS and its interface with the PAS telephone system provided the information necessary to analyze the number of incoming calls to the PAS. Data necessary to analyze and calculate inter-arrival times was accomplished through empirical data collection due to the inability of the ACD to capture individual call arrivals. A physical search of the files maintained by the PAS provided all the information necessary to recreate the provider and clinic templates

used by the PAS in creating the appointment schedules offered for beneficiary care. A search of the CHCS database also provided information on the provider and clinic appointment templates. Review of the Medical Command (MEDCOM) regulations and locally established protocols provided information on how clerks work with patients in determining the type of appointment needed to schedule beneficiaries seeking care. Interviews with PAS supervisors provided information on the intricacies needed to fully and accurately build the simulation model environment.

The processing of the raw data into meaningful information that could be utilized for model construction was accomplished using a combination of software programs. SPSS version 6.1 was used to calculate basic statistical information about the elements necessary to build the simulation. Bestfit version 2.1 was used to provide verification of basic statistical information but primarily served as a means to accurately identify the type of distribution that the different data sets represented. Proper identification became critical as ongoing experimentation during the model's development revealed that different data distribution types caused drastic changes in the model's performance.

Model Construction

The simulation model was developed to represent the status quo of the daily interactions in the PAS, beginning with the initial telephone call by the patient and continuing through to their placement in a clinical appointment within the facility. The model was built using MedModel Version 2, a healthcare simulation software published by ProModel Corporation of Orem, Utah. MedModel was chosen because it provides convenient features for conducting simulation experiments and is a simulation software this researcher is most familiar with.

The basis of this simulation was to find the steady state behavior of the patient appointment system. This model is therefore a nonterminating simulation. The steady state sought in this model is the state in which the PAS operates on a daily basis. The run length of the simulation therefore incorporates the entire operating hours of the PAS. Data was drawn from the previous and current year in the PAS management reports in an attempt to gain a picture of what a daily PAS workload is like over time. The model was then built around this typical day and run in a nine hour increment to simulate one working day. The model then runs five replications to represent a typical week's worth of activity.

The simulation for this project model was constructed in a four phased approach. This entailed constructing the model in stages as recommended by the MedModel software designers. This method allowed for certain elements of the model logic to be employed and debugged prior to moving on to more complex logical elements. The four phases utilized in the construction of this model were: (1) basic model entries, (2) resource development, (3) process logic development, and (4) animation refinements. The formatted listing of the model's construction is listed in Appendix B.

Phase I

The first phase consisted of incorporating all required basic model elements into the model. These elements include general information, locations, entities, and arrivals. The general information required by the software is identifying a model name for archiving purposes, specifying default time and distance units and developing or importing background graphics. Since all data collected on process activities were converted and calculated in seconds, the base time unit utilized in the model was seconds. Seconds more accurately reflect the activities this

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model simulates since many activities/processes occur within a one minute time span. Furthermore, seconds were used in describing or defining events because of the nature of the data collected. Background graphics to depict a floor plan for the PAS was built using Home Design for Windows Version 2.0 by Expert Software Inc., 1993. This floor plan was then imported into the MedModel graphics editor and placed as the behind grid graphic.

Locations represent fixed places in the model where entities are sent to undergo some process or wait while decisions are made concerning further routing. This model is comprised of five different locations: (1) entrance, (2) depart, (3) assistant supervisor service chair, (4) clerk service chair, and (5) wait area chair. *Entrance* is a single location where all entities will arrive and the place in the animated environment where the entity physically enters for processing. *Depart* is a single location where all entities will leave the system and the place in the animated environment where the entity physically leaves. *Assistant supervisor service chair* is a single location where patient calls are referred by a clerk when they are unable to fully process a patient call . In the daily PAS activities, this usually occurs when a clerk is unable to fit a patient into an appointment because of lack of knowledge or inexperience with patient care capabilities of a provider or clinic. *Clerk service chair* is a six unit multiple location where patient calls are processed by one of the six PAS clerks. *Wait area chair* is a ten unit multi-capacity location that has the ability to hold fifty entities. The capacity of fifty is representative of the approximate capacity of IACH's ACD queuing system. This wait area chair location is where patient calls that can not directly proceed to a clerk for processing are queued and wait.

Entities represent the patient calls being processed through the model. The model animates the patient call as a physical person and shows them moving through the process of

getting an appointment through the PAS. The animation shows when and how large queues build as patients wait to have their call answered by a clerk. It shows where in the process the appointment is made and who makes the appointment for the patient. The model also delineates and shows the special appointment cases that must be handled by the assistant supervisor.

Arrivals are the frequency, number, location, and inter-arrival time of new entities being introduced to the model environment. In this initial stage of model construction, the number of arrivals per day (cycle) were defined in a poisson distribution with a mean of 743 and a standard deviation of 196. All arrivals in the simulation occur at the location called entrance. The inter-arrival time of each call was defined in an exponential distribution with a mean of 50 seconds and a standard deviation of 53 seconds.

Phase II

The second phase of the model consisted of incorporating the PAS clerks and assistant supervisor (both resources) into the model. As resources in the model, the clerks and the assistant supervisor are the mechanisms for processing a patient call for an appointment. This is done either individually by each clerk or jointly with the assistant supervisor supporting a clerk to process an unusual or difficult request from a patient call. Each clerk is assigned to their own individual clerk service chair as the location where patient calls are directed and processed. The length of time calculated to process a patient call for a clerk was defined in a truncated positive normal distribution with a mean of 121 seconds and a standard deviation of 48 seconds. The assistant supervisor was assigned to the assistant supervisor service chair as the location where patient calls are directed and processed. The length of time calculated for the assistant supervisor to process difficult appointments was also defined in a truncated positive normal distribution with

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a mean of 422 seconds and a standard deviation of 304 seconds.

It would have been preferred to model the clerks as six independent resources but they were modeled as a multiple resource because of the limitations placed on the project by the student version of the MedModel software. Another limitation was that the model would only support a maximum of five resources. Because six clerks exceeds five resources, they were not able to be modeled as separate resources. However, this coincided well with using the multiple clerk service chairs as the locations where the clerks process the patient calls.

<u>Phase III</u>

The third phase of programming the process logic was developed utilizing the model flow diagram (See Appendix B) as the basic blueprint. The process logic defines everything that happens to an entity from the time it enters the model environment until it exits. This phase of model programming was the most intensive and time consuming. During this phase, the ground work of the basic model process logic was laid. First, a simple running model was developed. Then, different elements of the model were targeted for enhancement to provide a more realistic output. It is here in the third phase that most of the experimentation and analysis occured as a new element or piece of the model was added and then modified.

Two important enhancements added during this phase were an arrival cycle (See Table 1) for the patient calls and a work shift for the clerks. The arrival cycle defines the pattern of individual arrivals as they occur. The arrival cycle allowed the model to accurately simulate in more detail how the arrival of incoming patient calls fluctuates throughout the work day in the PAS. Analysis of the data collected revealed a pattern of how calls arrive.

Arrival Cycle of Patient Calls

Hour	Percentage of Total Arriving Calls
a.m. 6 to 7	1.10%
7 to 8	20.10%
8 to 9	8.10%
9 to 10	13.80%
10 to 11	21.30%
11 to 12	8.40%
p.m. 12 to 1	8.10%
1 to 2	9.90%
2 to 3	9.20%
Total 9 hours	**100.00%**

Table 1.

To apply the work shifts used by the clerks the shifts had to first be defined. Four shifts were defined in order to simulate the activities in the PAS. Two clerks were assigned to each of the three straight eight hour shifts. However, empirical observation proved the clerks do not work eight straight hours. For management to expect a flawless eight hour shift is impractical. Therefore, to add realism, the clerk's shifts included a morning and afternoon break as well as a short lunch break. The times in which these events occurred are staggered just as the clerks staggered themselves when they disengage from their workstation for breaks. The early shift has two clerks arriving at 0600 and working until 1400. Clerks working the regular shift arrive at 0700 and work until 1500 at which time the ACD is turned off by the PAS supervisor. The assistant supervisor was assigned its own independent shift. Adding the work shifts to the model

more accurately represents the daily PAS work environment and the availability of clerks to answer patient calls.

During phase III construction of the model, the random number stream generators had to be manipulated and adjusted to further enhance the model's accuracy. In the real world, events tend to happen randomly according to a certain statistical pattern or distribution. The simulation program uses numbers created by a random number generator to determine the sample values drawn for each defined distribution. Throughout the model, there are different distributions that define activities that drive the model. MedModel's random number generator produces a sequence of random numbers that repeat after a very long cycle. The beginning of a number sequence is dependent on the initial seed value used by the number generator. The same sequence of randomly generated numbers are repeated each time the same initial seed value is used to generate the number stream. Because of this, each of the different activities using probability distributions had to be programmed with their own number stream seed values.

Phase IV

In the last phase of model construction, the animation was tailored to bring a level of realism to the model. Great effort was taken to ensure that the visual power of the simulation was brought forth to the staff and managers. The visualization of the activities in the PAS allows those not intimately familiar with the PAS daily activities an opportunity to see a physical replication of the section's workload and processes. This phase consisted of developing and mapping path networks upon which entities (patient calls) and resources (clerks) move in the animated environment of the PAS. A path network was traced through the animated environment and activity nodes were associated with locations where a process or event was designated to take

place. Once the path networks were developed the network had to be mapped. Mapping the network consisted of identifying the locations to which entities (patient calls) and resources (clerks) move from one point to another on a designated path network. The number of background graphics were increased to represent the physical environment of the PAS work area. Lastly, the animated effects of the entities (patient calls) and resources (clerks) were modified to enhance the level of realism.

Process of Model Experimentation & Analysis

Each phase of construction as previously described underwent multiple iterations of a simple sequence where elements were developed, run on an experimental basis, and then analyzed to determine the accuracy of the model's output. It was in the third and fourth phases of model construction that most of the experimentation and analysis of output occurred. Face validation was used to make determinations about the accuracy of each added element and its effects on the model, as certain elements of the model were developed and tested. Each new addition or element in the model was tested to analyze its effect on the model's output. Some of this testing included modifying the distributions and the random number streams used by the simulation program as described in the phase III model construction. This method of running multiple iterations in a working model continued until a final product was reached.

In many instances, some additional data was required or a recalculation of distributions was necessary. Calculations for the inter-arrival times required further empirical data to be collected. The initial data collected did not produce calculations that provided useful information. In the construction of an operating test model, the initial type of distributions used were heuristically derived from the data. To accurately identify the appropriate distribution for an

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activity or process in the model, the data was analyzed using software that tests data set distributions. The software used in this effort was Bestfit written by Palisade Inc. The analysis made using the software Bestfit was critical to the success of the model. It was extremely difficult to determine an appropriate distribution pattern through visual inspection of the data displayed in histograms. The empirical selection of several of the data distributions used in the initial running models proved to be incorrect once the software analysis was completed.

Model Verification/Validation

Validation of a model is the process of verifying that the model has successfully replicated the system it supposedly simulates. Methodologies for validation can be categorized as either subjective or objective. Subjective methodologies utilize face validity as a means of assessing the simulation model. Face validity encompasses the use of people who are knowledgeable of the process being modeled to evaluate the reasonableness of the model's simulated outcome. Objective methodologies perform statistical comparison of the performance of the real world system with the output from the model. It is a more rigorous and robust method of validation and therefore a preferred method (Banks and Carson 1984, 514).

However, there are few published simulation studies of healthcare environments that use statistical validation (Lowery and Martin 1992, 28). If an output measure is important, and data exists on the measure in the study facility, and the measure is not likely to be sensitive to the assumptions, then statistical validation of the measure can and should be conducted. Otherwise, *face validation* is a reasonable alternative. "True validation is a philosophical impossibility and all we can do is either invalidate or 'fail to invalidate'. For this reason, what we actually seek to establish is a high degree of *face validity.*" (MedModel User's Guide 1995, 63)

This study uses face validation as the primary method to validate and verify the model. The subject matter experts utilized were the PAS supervisors and clinical managers most familiar with the PAS activities. Additionally, staff from the Information Management Division (IMD) that are responsible for the maintenance of the PAS portion of the CHCS also provided some input in validating the output of the simulation model. Verification of the model during critical junctions in the development of each phase of the model ensured that PAS processes and activities were accurately simulated. It is with the following philosophy that the output of the simulation model was read and interpreted.

> One should be careful about getting too academic about the precision of simulation output. Conway, Maxwell and Worona (1986) caution that attaching a statistical significance to simulation output can create a delusion that the output results are either more or less significant than they really are. They emphasize the practical, intuitive reading of simulation results. Their guideline is 'if you can't see it with the naked eye, forget it.' (MedModel Users Guide 1995, 75)

RESULTS

The results of this study are focused on analyzing the outcomes in two important areas: (1) the accuracy of the simulation model and (2) adequacy of the provider's appointment templates utilized by the PAS. The model was built to be used as an evaluation tool for two purposes, first as a means to either validate or refute the stigma associated with the PAS and second, as an instrument for future use in evaluating new alternatives and proposals for improving the PAS. Many previous supervisors, managers, process action teams, and previous researchers (Lashlee 1990, Mundy 1994, & Buzonas 1995) have proposed changes for the PAS, but were not fully successful in implementing changes that provided long term improvements. This model can assist in this process by providing an atmosphere in which proposals can be tested prior to

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implementation to assure the long term success of improvement changes. Additionally, analysis of the provider templates was done as a means to identify the availability of appointments for patients seeking care in the facility. This analysis provides information about the efficiency with which the primary care clinic operated during the study period.

The Model

To determine the accuracy of the model, a comparison of the model's output (expected) to the real environment (observed) was made. To gain an appreciation of the output produced by the simulation model (See Appendix C), one must have a knowledge and understanding of the data used to develop the model. This is necessary to create a basis from which conclusions can be drawn about the real environment (observed) versus the simulated model environment (expected). The critical data elements analyzed and used to develop the model can be broken into areas representing the length of time it takes to process patient calls, the quantity and frequency of patient calls entering the system, and the time beneficiaries wait for a clerk to process their appointment request.

Processing Time

Processing time is the total time it takes a clerk to process a patient call. This process starts with the receipt of the patient call and terminates after the patient is either placed in an appointment slot or told that their request for an appointment can not be filled at this time. Both the clerks' and assistant supervisor's processing times must be evaluated to determine the model's accuracy. The information in Table 2 was obtained from the end of day reports produced by the ACD system for the months July 95 through October 95.

Length of Time to Process a Call

	Number of Calls	Observed in ACD Data (Real)	Produced by Model (Expected)
Clerks	7832	Mean 121, Std Dev 48	Mean 120, Std Dev 45
Asst supervisor	46	Mean 422, Std Dev 304	Mean 446, Std Dev 76

Table 2.

The information in Table 2 reflects the length of time taken for a call to be processed by either the clerks or the assistant supervisor. The sample size and the data set for the clerks is representative of the cumulative total of each daily average computed by the ACD system and that reported by the ACD end of day report over the collection period. The same is not true for the sample data of the assistant supervisor. This is because the activity of assisting the clerks in the processing of complex or unusual patient requests by the assistant supervisor is not captured by the ACD system. This data was acquired through empirical collection in conjunction with all other data collection visits made to the PAS over the data collection period.

Quantity

The quantity and frequency of calls arriving into the appointment center was critical in developing an arrival cycle (Table 1) for the model that could accurately reflect the call traffic that occurs on a daily basis in the PAS. Arrivals for a model are typically placed in a poisson distribution. However, since data for this project was gathered over a four month period, a more accurate arrival rate was determined using the software Bestfit to analyze and determine the actual arrival distribution experienced in the PAS. Comparison of observed data and the model's output in Table 3 reflect the model's performance.

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Average Number of Arriving Calls per Day

	Observed in ACD Data (Real)	Produced by Model (Expected)
Mean	743	721
Standard Devivation	196	172
Minimum	349	460
Maximum	1157	1029

Table 3.

The information in Table 3 was obtained from the end of day reports produced by the ACD system for the months July 95 through October 95. The sample was comprised of the daily total of calls processed by PAS personnel as reported by the ACD system over the study period. The total number of complete reports suitable for use in the model's construction represented a sample size of 36. The sample size of data produced by the model was equal to the number of replications (20) programmed into the simulation for a total of 20 usable reports. The minimum and maximum number of calls give a representation of the range of calls experienced in the PAS and simulated by the model.

Time Spent in the Queue

The length of time patient calls wait to be processed by PAS personnel provides further insight into the accuracy of the model. Of particular importance is how long patient calls remain in the queue before being processed. The information in Table 4 displays how long patient calls remain in the queue before being serviced by PAS personnel. This information was obtained from the same information sources used in analyzing the other critical data elements and during the same time period. However, the sample size for the model data varies between the sample size of

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the real environment (observed) and the model environment (expected). The observed sample has

36 observations while the model has 20 observations. The difference is that the observed data

comes from the total number of complete ACD end of day reports (36) suitable for use in the

model's construction over the four month period. The model data comes from the results

obtained from each of the twenty iterations run as a representation of a typical month's workload

in the PAS.

Length of Time Spent in the Queue

	Observed in ACD Data (Real)	Produced by Model (Expected)
Overall AVG Length of Wait per Day	Mean 98 secs, Std Dev 36	Mean 89 secs, Std Dev 24
AVG Longest Wait per Day	Mean 537 secs, Std Dev 301	Mean 375 secs, Std Dev 313
Overall Longest Wait	1472 secs	1492 secs

Table 4.

The average length of wait per day in Table 4 reflects the length of time a patient waits in

the queue before being serviced by the appointment clerk or hangs up and exits the system. The

average longest wait per day is the calculation of the longest wait times experienced each day and

placed in the cumulative calculation over the data collection period. For the real data the sample

was 36 days and for the model data 20 days. Overall longest wait is the actual longest time that a

patient call waits in the queue before being processed by an appointment clerk or exiting the

system by hanging up.

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Appointment Templates

Analysis of the provider appointment templates provides further insight into the quantity and availability of appointments to the beneficiary population served by the primary care clinic. It is with these templates that the PAS clerks work to fill a provider's patient schedule. The number of sick call (SC) appointments must be evaluated separately because these appointments are for active duty service members only. All other appointment slots in the primary care setting are available to both AD and family members assigned to the clinic.

Daily Appointment Availability
(Ireland Family Medicine Clinic)

Max number of Appointments	Number of SC Appointments	Appointments Available for other than AD
118	53	65

Table 5.

Table 5 is an analysis of the number and type of appointments made available to the beneficiary population as submitted by the provider staff to the PAS supervisor. The information in Table 5 was obtained from CHCS end of month reports for the four month study period. As stated in the assumptions, the number of providers assigned to the clinic during this time period was held constant at four physicians and one nurse practitioner. Also, all providers were modeled to work an eight hour day. The length of the appointment times for the physicians was fifteen minutes for all sick call appointments and twenty minutes for all scheduled appointments. The nurse practitioner's length of appointment times for both sick call and scheduled appointments was twenty minutes. The only difference between providers was the amount of time each day a provider would be assigned to perform sick call before seeing appointed patients. the length of

time a provider is scheduled to perform sick call services is determined by the chief of the clinic and the administrative clinical manager.

Analyzing the utilization by beneficiaries of the available appointments demonstrates the degree to which the provider staff is utilized to provide patient care. It also provides some insight into the accessibility (quantity) of appointments to beneficiaries seeking care. The information in Table 6 was obtained in the same manner and during the same time period as described previously. Also, the same group of providers that staff the clinic comprised the study sample.

Appointment Utilization
(Ireland Family Medicine Clinic)

Month	Work Days	Max Appts	Appts Avail	Appts Booked	% Booked	% Max Cap Util
JUL	19	1235	98	78	79.59%	6.35%
AUG	22	1430	818	533	65.15%	37.27%
SEP	20	1300	883	638	72.25%	49.07%
OCT	20	1300	1055	946	89.67%	72.76%

Table 6.

Several calculations using an automated spreadsheet were required to produce the information in Table 6. *Maximum capacity* is the total number of appointments (other than sick call appointments) that could be made available for the given number of work days in the month times the number of appointments that could be made available each day in the clinic. This is possible if all the providers assigned to the clinic are present each day and that they are not pulled away for duties outside of their clinic. *Appointments available* is the actual number of appointments made available by the patient care provider staff present in the clinic for the given month. *Appointments booked* are the actual number of appointments made by beneficiaries

through the PAS as reported by the CHCS end of month report. *Percent booked* is the number of *appointments booked* divided by the number of *appointments available*. The *percent of maximum capacity utilized* is the *maximum number of appointments* divided by the number of *appointments booked*.

DISCUSSION

The data collected to complete the building of the simulation model and the analysis of appointment utilization provide the facility with useful factual information. This information can be utilized in the continued development of the facility's business planing and its process improvement efforts. The information produced by this study meets the objectives and purpose for this research project. The model is capable of being used as a mechanism to test proposals focused on improving PAS operations that are anticipated to enhance patient satisfaction. Additionally, the model provides a means with which management can partially disprove the stigma associated with the PAS. Lastly, the analysis of the appointment templates identifies that IACH is currently capable of meeting access standards in the primary care setting.

The model resembles the PAS operations as accurately as possible given the constraints and limitations of the MedModel student version software. Of note is that the simulation model actually displays a more efficient PAS operation than what actually occurs in the real work environment. This is attributable to the fact that the simulation is a mechanized model of a humanistic environment. The model cannot accurately reflect the personalities and intricacies of each of the PAS clerks. The some of the finer nuances of when a clerk might ask for help from another co-worker or receive constructive criticism from a supervisor in the handling of a patient call do not exist in the model. However, some of these different activities have been placed in the

model such as breaks. If the model is programmed for a ten minute break it places the clerk on break for ten minutes and after ten minutes the clerk is immediately back to work. In the real environment, if the clerk must take a break to perform some personal function, this may actually take more or less time than what is programmed into a simulation model. Because of these concerns, the model's superior efficiency performance can be deemed a weakness of the model and this study. Therefore, when the model is used as an analysis tool for evaluating proposals, its output must be prudently interpreted .

The simulation model constructed can successfully replicate the current activity of the PAS given a few limitations imposed by the student software version of MedModel utilized in this project. It is the opinion of this researcher that the model can be successfully used to resolve or reduce some of the stigma associated with the PAS. The model can be run on any laptop PC and easily presented to the healthcare providers and hospital staff. The model will display the daily activity for observation by the audience. The visual power of the simulation model should provide the staff insight on how their activities such as changes in block releases of appointments and their interactions such as tardiness in their delivery of templates for input into the CHCS appointment module effect the performance and service capabilities of the PAS.

The simulation model will allow the staff to visualize the appointment process as experienced by the patients attempting to seek care. With this knowledge, the staff should be able to grasp problematic areas in the facility's appointment process and understand why patients are not satisfied with the PAS, as identified in the Grey study. One of the more obvious events that should be evident to viewers of the simulation, is that at different times of the day the length of the queue in the ACD grows significantly. The inability to access an appointment clerk is a stigma

associated with the PAS. At certain times of the day in many instances patients dialing into the PAS will wait to speak with an appointment clerk.

Patients are not fond of waiting. This study found that on average 56 (with a standard deviation of 42) calls to the PAS are terminated by the caller after waiting approximately 98 (with a standard deviation of 36) seconds. Further analysis of the EOD report showed that the average daily abandonment rate by patients of 56 (SD 42) calls represents 7.6% of the total daily number of calls made into the PAS. Therefore, in order for this facility to satisfactorily respond to 92.4% or greater of all patient calls, these calls must be answered within 98 seconds. Patients' must be given prompt courteous service in responding to their appointment needs when calls are answered. This means that the PAS clerks must be able to place the patient in an appointment that meets the patient's needs.

For beneficiaries seeking primary care, this is not currently a difficult task for the PAS clerks to accomplish. Results of the provider template analysis show that approximately 17.3% of the available primary care appointments went unfilled over the course of the study period. In contrast, when measuring the maximum capacity of appointments that could be made available to patients, the percentage of available appointments increases to approximately 41.4%. This large percentage of open/unfilled appointments signifies that a large unused capacity exists within the primary care setting of this facility. Because of this unused capacity, it can be reasonably stated that the facility can presently meet its primary care access standards of providing care as required under the TRICARE contract. Patients seeking services in the primary care environment of this facility can definitely be seen within the following time frames:

* 4 weeks for a well visit (health maintenance and prevention non-urgent)

* 1 week for a routine visit (intervention required, non-urgent)
* 1 day for acute illness care (early intervention required, urgent)

The method that the facility and providers use to project and implement the appointment templates is the fundamental determinant of whether the PAS becomes an obstacle to patients seeking care. It may also work to hinder the providers trying to place patients in follow-up appointments or attempting to refer patients to specialty care areas. As the research to develop the model unfolded, there were several outstanding issues that became self-evident as to why the PAS has become stigmatized. Research discovered that appointments are released on a block system that causes patients to compete with each other in order to obtain appointments. This is especially evident in the specialty care areas where in many instances care is very limited for non-AD beneficiaries. It is because of this block release system where a specific clinic or area releases an appointment schedule to the PAS for specified number of weeks in the future that beneficiaries compete. It is in the specialty clinics (e.g. dermatology, allergy, and ophthalmology) where the facility has only one provider, that beneficiaries are most adamant in seeking care. The arrival cycle defined in the simulation model reflects this beneficiary activity of competing for these appointments.

The arrival cycle (Table 1) shows that 0800 and 1000 hours are peak arrival times for patient calls. It is during these times that patient calls will most likely be placed in the ACD queue. The 0800 and 1000 hour peak arrival times exist for two reasons. The first, is that 0800 hours is the first time of the day in which non-AD beneficiaries can begin to schedule appointments. Approximately 20.1% of calls made during the day occur during the 0800 to 0900 time frame. It is during this hour that beneficiaries seeking same day appointments attempt to

access the PAS to obtain an appointment time most convenient to them. The second, at 1000 hours is the time when on specified days of the month each clinic releases its next two week block of appointments. The arrival cycle table displays that 21.3% of all calls during the day are made to the PAS from 1000 to 1100 hours.

The arrival cycle (Table 1) also shows that the third highest peak hour is the 0900 to 1000 time frame. This reflects those patients that attempt to beat the 1000 hour release time of block appointments the clinics, but are denied access and are told to call after 1000 hours. This determination was made from information obtained during interviews with the PAS clerks and during the empirical data collection while observing and listening to the clerks perform their duties. The 0900 hour arrival cycle receives approximately 80% of its hour's worth of calls in the five to ten minutes before 1000. The simulation model spreads this hour's worth of calls just as it does with all hours in the arrival cycle, evenly over the course of each sixty minute time period. It is this efficiency in the model that is not representative of the real environment in the PAS. It is also why on average patients wait longer in the real (observed) environment than they do in the model (expected) environment.

This researcher proposes that it is this competition by beneficiaries to be in the front of the queue to get the few specialty care appointments, that creates the stigma associated with the PAS. In many cases, these clinics may only offer twenty appointments to non-AD beneficiaries over the two week block period. In reality, these appointments may be filled within the first ten minutes of being released by the PAS. Those that can not properly time their arrival in the queue view the PAS as being inadequate and unresponsive to their needs. Thus the PAS has come to be viewed as the problem, because in many instances the beneficiaries may not be aware of the extremely

limited availability of services. The PAS clerks must directly interface with the patient population seeking care. The reality is the facility and clinics as a system fail to meet the patient's needs and expectations.

The service provided by the specialty care clinics was outside of the scope of this project, however, it is the opinion of this researcher that the specialty care clinics can not meet the access standards as described in the TRICARE contract. The access standards require specialty care appointments will be provided within:

* 4 weeks for a routine visit
* 1 day for urgent care

It is in this specialty care area, that the facility has identified in its business planning efforts the available resources fall short of patient needs. However, the facility must and should focus on resolving this issue to better meet the needs and expectations of the beneficiary population. It is here that further research could be focused to resolve the specialty care needs of the beneficiary population, and improve the facility's capability of meeting the TRICARE access standards.

CONCLUSIONS & RECOMMENDATIONS

Conclusions

In the construct of the simulation model, an indepth and institutional knowledge was gained by this researcher about the appointment process in IACH. As stated by Levin et. al. 1992, for the simulation model builder to be effective, there must be a familiarity with the process attempted to be simulated. Without the gained knowledge of the process, it would have been extremely difficult to determine if the model was producing valid outcomes during the experimentation phase. Numerous visits to the patient appointment center were required to

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develop a sense of the processes at work in the operational environment. Discussions and comparisons of interim results with the PAS clerks and supervisors provided insight and clarity to assumptions and perceptions of their activities.

The resulting model as a product of this project is accurate enough to meet its intended purpose. The model as constructed is capable of being utilized in making and analyzing assumptions about the feasibility of adding or deleting services in the PAS. The model has the ability to analyze any suggestions that effect the staffing, workload, processing time, and routing of patient calls by the PAS personnel. The visual display of the PAS activities meets the intended purpose for use as a device to discredit the stigma associated with the PAS. The simulation also serves as a tool to educate the facility's staff about the appointment process that beneficiaries must utilize to obtain care in the facility. The model should educate providers and staff as to why the PAS is viewed as an obstacle to accessing care.

The analysis of the provider templates provides information of the facility's ability to expand and meet its future obligations identified in its proposed business plan of establishing several 10,000 member beneficiary primary care modules. The Ireland Family Medicine Clinic has been established as the first empaneled primary care clinic. The clinic is currently being tested to determine its ability to meet its empaneled population health care demands. This clinic was the focus of this study to determine if the facility is on the right track in posturing itself for the implementation of TRICARE under the Region 5 contract.

The timeliness of this study offers an additional source of information to the facility as it prepares to move towards TRICARE. The data collection period for IACH is scheduled to begin August 96. If this study can result in analyzing improvements to operations within the facility by

increasing customer satisfaction then patients will be more likely to utilize the MTF and enroll in the MTF TRICARE Prime offering instead of the Contractors Prime network. Increased enrollment in the MTF Prime will mean more CHAMPUS dollars being budgeted for the facility under the TRICARE Alternative Financing and allow the facility to initiate more programs to recapture CHAMPUS dollars.

Recommendations

It is anticipated that this study will be utilized to educate the providers and staff of IACH about how the PAS functions as an entity and as an extension of the clinics it serves. Any stigma associated with the PAS is reflective of the clinics it services, and ultimately affects the patient care provided within those clinical areas. Continuous efforts must be made to improve the efficiency with which patient care is provided in the facility's clinical setting. This is critical as the military continues to downsize and face increased budgetary constraints. The appropriate use of physician's time and appointment templates must be managed to best suit the needs of the beneficiary population and adequately enable the physician to provide quality treatment to the patient. The construction of appointment templates offered by clinics for use in the PAS must continually be evaluated by the clinical managers. This is necessary to define the best mix of both the number and type of appointments available to the patients, which can then be properly translated and utilized by the PAS.

Future research should focus on an indepth assessment of specialty care needs of the patient population served by IACH. It is here that much of the facility's CHAMPUS expenditures can be recaptured. The research should focus on the accessibility and availability of these services to the IACH beneficiary population.

Other research efforts should also target elements and services provided within the facility that can be outsourced such as PAS, Patient Records, Transcription services, Advice Nurse, Logistics, Dietary services, and Ambulance services. Lastly, efforts could be made in extending the abilities of non-physician providers. Within the DoD MTF system, this could mean the expansion of the roles of the 91B (field medic) and 91Cs (LPN licensed practical nurse) in providing portion of health care on a level between their current function and that of an NP or PA. This expanded role would enhance their training as well as improve battlefield capability. It could also further reduce some of the case load that physicians are now required to treat. There are already tasks that the 91Bs and 91Cs perform in the MTF environment that are not evident in the civilian setting. Research could be focused on taking advantage of this unique situation and help to reduce some of the stress felt by MTF physicians as professional staffing levels continue to decrease at a much faster rate than the beneficiary population and their health care demands.

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Appendix A

Model Flow
Chart

```
   ( Start          )
   ( Pt Appt System )
          |
          v
   +------------------+
   | Pt dials PAS     |
   | telephone number |
   +------------------+
          |
          v
      < Is PAS          >  --Yes-->  +--------------------+  -->  +---------------------+  -->  +-------------------+
      < Clerk Available? >           | Clerk Begins Appt  |       | Clerk & Pt identify |       | PAS clerk searches|
          |                          | Scheduling Process |       | type of appt needed |       | for appt          |
          No                         +--------------------+       | and clinic for care |       +-------------------+
          |                                  ^                    +---------------------+              |
          v                                  |                                                         v
   +------------------+                      ( D )                                           < Are appts for      >
   | Pt call goes to  |                                                ( B ) <--Yes--        < clinic available?  >
   | Call Waiting     |                                                                            |
   | Queue            |                                                                            No
   +------------------+                                                                            |
          |                                                                                        v
          v                                                                            +-------------------+
      < Is Call Waiting >  --Yes-->  +-----------------------+  -->  ( End )            | PAS Clerk notifies|
      < Queue full?     >            | Pt call attempted     |                          | Pt that appt is   |
          |                          | denied access         |                          | not available.    |
          No                         | (stats captured)      |                          +-------------------+
          |                          +-----------------------+                                   |
          v                                                                                      v
   +------------------+                                                                         ( C )
   | Pt call is       |
   | placed in the    |
   | queue.           |
   +------------------+
          |
          v
        ( A )
```

A-2

A

Does Pt wait for next avail clerk? —Yes→ **D**

No
↓

Pt exits system by hanging up. (stat captured)

↓

End

C

Can Pt use Same Day appt? —Yes→ Is Same Day appt available?

No
↓

Appt is not made ←——No——

Yes

↓

Can Pt be put on waiting list?

Appt not made (stat captured) ←—No—

↓

End

Yes
↓

PAS clerk puts Pt on waiting list of clinic care was initially sought in.

↓

Pt put on waiting list (stat captured)

↓

End

B

↓

PAS clerk makes appt notifies pt of time, date, & clinic. ←——

↓

Appt made (stat captured)

↓

End

Appendix B

```
*****************************************************************
*                                                               *
*              Formatted Listing of Model:                      *
*              C:\MMSTU\MODELS\CREATED\PACPAS.MOD                *
*                                                               *
*****************************************************************
```

Time Units: Seconds
Distance Units: Feet

```
*****************************************************************
*                        Locations                             *
*****************************************************************
```

Name	Cap	Units	Stats	Rules	
Entrance	1	1	Detailed	Oldest,	
Depart	1	1	Detailed	Oldest,	
Asst_Supervisor_Svc_Chair	1	1	Detailed	Oldest,	
Clerk_Svc_Chair	1	6	Detailed	Oldest,	First
Clerk_Svc_Chair.1	1	1	Detailed	Oldest,	
Clerk_Svc_Chair.2	1	1	Detailed	Oldest,	
Clerk_Svc_Chair.3	1	1	Detailed	Oldest,	
Clerk_Svc_Chair.4	1	1	Detailed	Oldest,	
Clerk_Svc_Chair.5	1	1	Detailed	Oldest,	
Clerk_Svc_Chair.6	1	1	Detailed	Oldest,	
Wait_Area_Chair	5	10	Detailed	Oldest,	First
Wait_Area_Chair.1	5	1	Detailed	Oldest,	
Wait_Area_Chair.2	5	1	Detailed	Oldest,	
Wait_Area_Chair.3	5	1	Detailed	Oldest,	
Wait_Area_Chair.4	5	1	Detailed	Oldest,	
Wait_Area_Chair.5	5	1	Detailed	Oldest,	
Wait_Area_Chair.6	5	1	Detailed	Oldest,	
Wait_Area_Chair.7	5	1	Detailed	Oldest,	
Wait_Area_Chair.8	5	1	Detailed	Oldest,	
Wait_Area_Chair.9	5	1	Detailed	Oldest,	
Wait_Area_Chair.10	5	1	Detailed	Oldest,	

```
*****************************************************************
*                        Entities                              *
*****************************************************************
```

Name	Speed (fpm)	Stats

Animation of patient call processed through the PAS.
Patient_call   300   Detailed

Animation of patient calls forwarded to Asst supervisor for resolution.
Pt_call_Supervisor_Assisted 300   Detailed

****
                              Path Networks
****

Name	Queuing	T/S	From	To	BI	Dist/Time	Speed Factor
Net_Pt_call	No	Time	N1	N2	Bi	0.14	1
			N2	N3	Bi	0.21	1
			N3	N4	Bi	0.24	1
Net_Sup_Asst_call	No	Time	N1	N2	Bi	0.18	1
			N1	N3	Bi	0.08	1
			N1	N4	Bi	0.27	1
Net_Depart_wo_Svc	No	Time	N1	N2	Bi	0.35	1

****
                              Interfaces
****

Net	Node	Location
Net_Pt_call	N1	Entrance
	N2	Wait_Area_Chair
	N3	Clerk_Svc_Chair
	N4	Depart
Net_Sup_Asst_call	N2	Asst_Supervisor_Svc_Chair
	N3	Clerk_Svc_Chair
	N4	Depart
Net_Depart_wo_Svc	N1	Wait_Area_Chair
	N2	Depart

****
                              Mapping

```
********************************************************************************

Net                From      To      Dest
-----              ----      --      ----
Net_Pt_call        N1        N2      N2
                   N2        N3      N3
                   N3        N4      N4
Net_Sup_Asst_call  N3        N1      N2
                   N2        N1      N3, N4
Net_Depart_wo_Svc  N1        N2      N2

********************************************************************************
                              Resources
********************************************************************************

                                        Res          Ent
Name             Units  Stats    Search       Search   Path   Motion
----             -----  -----    ------       ------   ----   ------
Clerk            6      By Unit  Least Used   Oldest          Empty: 114 fpm
                                                              Full:  114 fpm

Asst_Supervisor  1      By Unit  None         Oldest          Empty: 114 fpm
                                                              Full:  114 fpm

********************************************************************************
                              Processing
********************************************************************************

Entity          Location          Operation       Blk   Output
------          --------          ---------       ---   ------
Patient_call    Entrance          Graphic 2       1     Patient_call
Patient_call    Wait_Area_Chair   Graphic 1       1     Patient_call
Patient_call    Clerk_Svc_Chair   Graphic 1
                                  Callhandle=1
                                  GET Clerk
                                  ^N(121,48,1)
                                  FREE Clerk
                                  Graphic 2       1     Patient_call
```

```
Patient_call              Depart                          Graphic 2                                    1   Patient_call
Patient_call              Asst_Supervisor_Svc_Chair       Graphic 2                                        Rename as Pt_call_Supervisor_Assisted
                                                          Callhandle=2

Pt_call_Supervisor_Assisted  Asst_Supervisor_Svc_Chair    Graphic 1                                    1   Pt_call_Supervisor_Assis
                                                          GET Asst_Supervisor
                                                          ^N(422,304,2)
                                                          FREE Asst_Supervisor
                                                          Graphic 2

Pt_call_Supervisor_Assisted  Depart                       Graphic 2                                    1   Pt_call_Supervisor_Assis
Pt_call_Supervisor_Assisted  Clerk_Svc_Chair              Graphic 1                                    1   Pt_call_Supervisor_Assis
                                                          GET Clerk
                                                          ^N(65,35,3)
                                                          FREE Clerk
                                                          Graphic 2

Pt_call_Supervisor_Assisted  Depart                       Graphic 2                                    1   Pt_call_Supervisor_Assis
                                                                                                       1   Pt_call_Supervisor_Assis

************************************************************************************
                                      Arrivals
************************************************************************************

Entity        Location   Qty each                           First Time  Occurrences  Frequency  Logic
------        --------   --------                           ----------  -----------  ---------  -----
Patient_call  Entrance   N(743,196,4); Pt_call_arrivals     0           1            E(50,53,5)

************************************************************************************
                              Location Shift Assignments
************************************************************************************

File Name                                Disable   Members
---------                                -------   -------
C:\MMSTU\MODELS\CREATED\EARLY.           No        Clerk_Svc_Chair.1, Clerk_Svc_Chair.2
C:\MMSTU\MODELS\CREATED\REGULA           No        Clerk_Svc_Chair.3, Clerk_Svc_Chair.4
C:\MMSTU\MODELS\CREATED\REGULA           No        Clerk_Svc_Chair.5, Clerk_Svc_Chair.6
C:\MMSTU\MODELS\CREATED\ASSTSU           No        Asst_Supervisor_Svc_Chair
```

```
*********************************************************
                  Resource Shift Assignments            *
*********************************************************
```

File Name	Resource	Units	Off-shift Node	Break Node	Disable
C:\MMSTU\MODELS\CREATED\EARLY.	Clerk	2			No
C:\MMSTU\MODELS\CREATED\REGULA	Clerk	2			No
C:\MMSTU\MODELS\CREATED\REGULA	Clerk	2			No
C:\MMSTU\MODELS\CREATED\ASSTSU	Asst_Supervisor	1			No

```
*********************************************************
                        Attributes                      *
*********************************************************
```

ID	Type	Classification
- Clerk handle call		
- Clerk refer call to Asst Supervisor		
Callhandle	Integer	Entity

```
*********************************************************
                      Arrival Cycles                    *
*********************************************************
```

ID	Qty / %	Cumulative	Time (Hours)	Value
Pt_call_arrivals	Percent	No	1	1.1
			2	20.1
			3	8.1
			4	13.8
			5	21.3
			6	8.4
			7	8.1
			8	9.9
			9	9.2

```
*********************************************************
                      External Files                    *
*********************************************************
```

ID	Type	File Name	Prompt
(null)	Shift	C:\MMSTU\MODELS\CREATED\EARLY.SFT	
(null)	Shift	C:\MMSTU\MODELS\CREATED\REGULAR.SFT	
(null)	Shift	C:\MMSTU\MODELS\CREATED\REGULAR1.SFT	
(null)	Shift	C:\MMSTU\MODELS\CREATED\ASSTSUP.SFT	

B-7

	AM 12	1	2	3	4	5	6	7	8	9	10	11	PM 12	1	2	3	4	5	6	7	8	9	10	11
Sun																								
Mon																								
Tue																								
Wed																								
Thu																								
Fri																								
Sat																								

B-8

	AM 12	1	2	3	4	5	6	7	8	9	10	11	PM 12	1	2	3	4	5	6	7	8	9	10	11
Sun																								
Mon																								
Tue																								
Wed																								
Thu																								
Fri																								
Sat																								

B-9

	AM 12	1	2	3	4	5	6	7	8	9	10	11	PM 12	1	2	3	4	5	6	7	8	9	10	11
Sun																								
Mon								█	█	█	█	█	█	█	█									
Tue								█	█	█	█	█	█	█	█									
Wed								█	█	█	█	█	█	█	█									
Thu								█	█	█	█	█	█	█	█									
Fri								█	█	█	█	█	█	█	█									
Sat																								

B-10

	AM 12	1	2	3	4	5	6	7	8	9	10	11	PM 12	1	2	3	4	5	6	7	8	9	10	11
Sun																								
Mon							■	■	■	■	■	■	■	■	■									
Tue							■	■	■	■	■	■	■	■	■									
Wed							■	■	■	■	■	■	■	■	■									
Thu							■	■	■	■	■	■	■	■	■									
Fri							■	■	■	■	■	■	■	■	■									
Sat																								
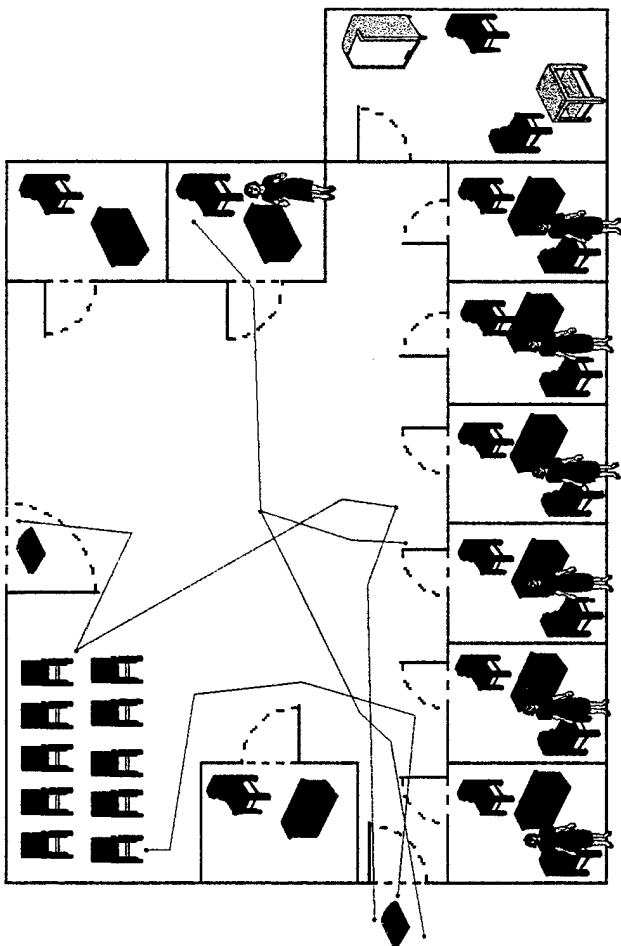
Appendix C

C:\mmstu\output\pacpas.res - c:\mmstu\output\pacpas.res

MedModel 2.02 Results for C:\MMSTU\MODELS\CREATED\PACPAS.MOD []

Date: Apr/02/1996   Time: 08:27:53 PM

Replication   : 20 of 20
Warmup Time   : 0 Hours   0.00 Minutes
Simulation Time: 9 Hours   0.00 Minutes

SINGLE CAPACITY LOCATIONS

Name	Scheduled Hours	Total Entries	Final contents	Avg Seconds Per Entry	Std Dev	Avg Opn Seconds Per Entry	% Operation	% Setup	% Empty	% Waiting	% Blocked	% Down
Entrance	9	664	0	0.00	0.00	0.00	0.00	0.00	100.00	0.00	0.00	0.00
Depart	9	662	0	0.00	0.00	0.00	0.00	0.00	100.00	0.00	0.00	0.00
Asst_Supervisor_Svc_Chair	8	15	0	421.64	307.56	421.63	21.08	0.00	78.92	0.00	0.00	0.00
Clerk_Svc_Chair.1	7	148	0	122.44	44.81	122.44	68.56	0.00	31.44	0.00	0.00	0.00
Clerk_Svc_Chair.2	7	133	0	118.53	45.79	118.53	59.42	0.00	40.58	0.00	0.00	0.00
Clerk_Svc_Chair.3	7	128	0	119.31	51.72	116.87	56.67	0.00	42.15	0.00	0.00	0.00
Clerk_Svc_Chair.4	7	102	1	125.03	84.52	118.26	45.69	0.00	51.69	0.01	1.18	0.00
Clerk_Svc_Chair.5	7	95	1	115.15	50.69	115.15	41.44	0.00	58.56	0.00	2.61	0.00
Clerk_Svc_Chair.6	7	61	0	133.75	41.81	133.75	30.90	0.00	69.10	0.00	0.00	0.00
Clerk_Svc_Chair	44	667	2	121.45	54.74	119.95	50.46	0.00	48.91	0.00	0.63	0.00

MULTICAPACITY LOCATIONS

Name	Scheduled Hours	Capacity	Total Entries	Avg Seconds Per Entry	Avg Contents	Std Dev	Max Contents	Final Contents	% Util	% Down
Wait_Area_Chair.1	9	5	654	11.78	0.24	0.81	5	0	4.75	0.00
Wait_Area_Chair.2	9	5	10	141.26	0.04	0.37	5	0	0.87	0.00
Wait_Area_Chair.3	9	5	0	0.00	0.00	0.00	0	0	0.00	0.00
Wait_Area_Chair.4	9	5	0	0.00	0.00	0.00	0	0	0.00	0.00
Wait_Area_Chair.5	9	5	0	0.00	0.00	0.00	0	0	0.00	0.00
Wait_Area_Chair.6	9	5	0	0.00	0.00	0.00	0	0	0.00	0.00
Wait_Area_Chair.7	9	5	0	0.00	0.00	0.00	0	0	0.00	0.00
Wait_Area_Chair.8	9	5	0	0.00	0.00	0.00	0	0	0.00	0.00
Wait_Area_Chair.9	9	5	0	0.00	0.00	0.00	0	0	0.00	0.00
Wait_Area_Chair.10	9	5	0	0.00	0.00	0.00	0	0	0.00	0.00
Wait_Area_Chair	450	50	664	13.73	0.03	0.29	10	0	0.56	0.00

RESOURCES

Name	Units	Scheduled Hours	Total Times Used	Avg Seconds Per Use	% In Use	Avg Travel To Use	% Travel To Use	Avg Travel To Park	% Travel To Park	% Idle	% Blocked	% Down
Clerk.1	1	9	115	117.75	41.79	-	-	-	-	58.21	-	0.00
Clerk.2	1	5	103	117.73	67.25	-	-	-	-	32.75	-	0.00

C:\mmstu\output\pacpas.res - c:\mmstu\output\pacpas.res

Clerk.3	1	9	109	124.98	-	42.05	-	57.95	-	0.00
Clerk.4	1	9	114	119.08	-	41.90	-	58.10	-	0.00
Clerk.5	1	9	114	119.13	-	41.92	-	58.08	-	0.00
Clerk.6	1	9	112	121.06	-	41.85	-	58.15	-	0.00
Clerk	6	50	667	119.95	-	44.44	-	55.56	-	0.00
Asst_Supervisor	1	8	15	421.63	-	21.08	-	78.92	-	0.00

NODE ENTRIES FOR Net_Pt_call

Name	Total Entries	Blocked Entries	Name	Total Entries	Blocked Entries
N1	0	0	N2	0	0
N3	0	0	N4	0	0

NODE ENTRIES FOR Net_Sup_Asst_call

Name	Total Entries	Blocked Entries	Name	Total Entries	Blocked Entries
N1	0	0	N2	0	0
N3	0	0	N4	0	0

NODE ENTRIES FOR Net_Depart_wo_Svc

Name	Total Entries	Blocked Entries	Name	Total Entries	Blocked Entries
N1	0	0	N2	0	0

ENTITIES

Name	Total Exits	Final Qty In System
Patient_call	647	2
Pt_call_Supervisor_Assisted	15	0

LOCATION ENTRIES BY ENTITY TYPE

Location Name	Entity Name	Total Entries	Total Processed	Avg Opn Seconds	Std Dev	Avg Wait Seconds	Std Dev	Avg Blocked Seconds	Std Dev	Avg Process Seconds	Std Dev
Entrance	Patient_call	664	664	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Depart	Patient_call	647	647	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

C:\mmstu\output\pacpas.res - c:\mmstu\output\pacpas.res

Asst_Supervisor_Svc_Chair	Pt_call_Supervisor_Assisted	15	15	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Patient_call	15	15	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Clerk_Svc_Chair	Pt_call_Supervisor_Assisted	0	15	421.63	307.57	0.00	0.06	0.01	0.03	421.64	307.56
	Patient_call	664	662	120.27	46.80	0.00	0.00	1.51	28.78	121.79	54.76
Clerk_Svc_Chair.1	Pt_call_Supervisor_Assisted	3	3	74.38	41.21	0.00	0.00	0.00	0.00	74.38	41.21
	Patient_call	148	148	122.44	44.81	0.00	0.00	0.00	0.00	122.44	44.81
Clerk_Svc_Chair.2	Patient_call	133	133	118.53	45.79	0.00	0.00	0.00	0.00	118.53	45.79
Clerk_Svc_Chair.3	Patient_call	126	126	117.29	47.07	0.00	0.00	2.48	24.28	119.77	51.86
	Pt_call_Supervisor_Assisted	2	2	90.45	42.98	0.00	0.00	0.00	0.00	90.45	42.98
Clerk_Svc_Chair.4	Patient_call	102	101	118.60	49.44	0.01	0.15	6.82	68.53	125.44	84.84
Clerk_Svc_Chair.5	Patient_call	94	93	116.35	50.50	0.00	0.00	0.00	0.00	116.35	50.50
	Pt_call_Supervisor_Assisted	1	1	42.24	0.00	0.00	0.00	0.00	0.00	42.24	0.00
Clerk_Svc_Chair.6	Patient_call	61	61	133.75	41.81	0.00	0.00	0.00	0.00	133.75	41.81